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VARIATIONS IN THE TENSILE STRENGTH OF RUBBER-SULPHUR VULCANISATES.

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Introduction.—Raw rubber which is contaminated by grit and other foreign matter is said to be unsuitable for many trade requirements and thererefore has an inferior market value. As a result of discussion with manufacturers and a review of the literature dealing with the problems of handling, transporting and marketing plantation rubber an endeavour has been made to investigate the meaning of dirty rubber with the object of establishing criteria for determining when raw rubber should be classified as dirty.

In the course of this work some observations have been made on the variations which occur in the tensile strength of vulcanised rubber and it is thought that these should be placed on record although we are aware of the generally accepted opinion that the average tensile strength of standard plantation rubber is at present satisfactory.*

The figures recorded refer entirely to tensile tests on vulcanisates of rubber and sulphur in the proportions of nine parts of rubber to one part of sulphur; according to the procedure adopted at the Department of Agriculture, F.M.S. and S.S. (See Bull. 27 F.M.S. and S.S. Dept. of Agriculture.)

It appears that our results are in agreement with those obtained by other workers with different proportions of rubber and sulphur, although, we are aware that, the "ten per cent sulphur" mixes have a sharper maximum tensile strength than the mixes with lower (1) sulphur content, and it is not unlikely that the deviations in load at break will be accentuated, even in the case of strong clean first grade rubber.

Experimental.—Average figures which were obtained in experiments designed to test the uniformity in tensile properties of crepe prepared from bulked latex are given in Table I.

In one experiment (No. 271) fifty gallons of latex were bulked, diluted to a dry rubber content of three pounds per gallon and strained through a sieve of fifty meshes to the linear inch. The necessary quantity of acetic acid was stirred in and the latex was immediately poured into one gallon pans for coagulation. The

* De Vries—"Rubber on the market and in the Factory".

coagulum from pans A to K was machined twenty-four hours afterwards, while the coagulum from other pans, V, W, X, etc. was allowed to mature for seven days before being creped. The rubber was eventually treated in a uniform manner according to standard practice, and all samples were mixed and calendered by one operator.

In a second experiment (No 277) a series of samples were made from ordinary and from matured coagulum as in experiment 271 but the work was carried out on an estate and there is less difference in the rate of vulcanisation of the two series of samples 277, 1 to 9 and 277, 11 to 21. The rubber was mixed with sulphur, vulcanised the next day and the vulcanised rings were tested on the third day. The figures were compared only for rings cured at the optimum time of vulcanisation, therefore all breaking loads lie on the same standard curve for Load, Elongation.

TABLE 1.

Sample.	Number of Tests.	Optimum time of Cure Minutes.	Mean Load at Break kgs./sq. mm.	Coefficient of Deviation per cent from Mean B/L. ±
271 A	8	180	1.19	10.5
„ B	8	180	1.25	6.5
„ C	8	180	1.13	13.2
„ D	8	180	1.13	9.4
„ E	8	180	1.11	7.9
„ F	8	180	1.00	11.3
„ G	8	180	1.18	6.3
„ H	8	180	1.11	8 5
„ K	8	180	1.15	5.5
„ X	8	80	1.26	17.0
„ Y	8	80	1.25	8.0
„ Z	8	80	1.17	12.5
„ V	8	80	1.20	13.7
„ W	8	80	1.18	13.3
277 i	14	220	1.18	13.7
„ ii	14	220	1.23	11.2
„ iii	14	220	1.26	9.5
„ iv	14	220	1.31	6 0
„ v	14	220	1.23	8.7
„ vi	14	220	1.31	5.0
„ vii	14	220	1.25	7.0
„ viii	14	220	1.13	28.8
„ ix	14	220	1.27	8.0
„ 11	10	150	1 33	13.4
„ 14	10	150	1.14	47.5
„ 19	10	150	1.00	44.3
„ 20	10	150	1.40	12.7
„ 21	8	150	1.41	3.7

These results are of importance in showing the high deviation from the mean Load at Break which can occur in rubber that was presumed to be uniform (2).

The variations which can occur in stored rubber (3 years' old) are shown by the figures in Table 2. In Experiment 272 five separate mixings were made from portions of crepe from the same batch. Mixes A and B were carried out by one operator (X) and mixes C, D and E were carried out by another operator (Y).

Although the figures cannot be taken as representative of the behaviour of stored rubber (3) it is ovident from the data at our disposal that the results quoted are not abnormal.

TABLE 2.

Sample.	Description.	Number of Tests.	Optimum time of Cure. Minutes.	Mean Load at Break. kgs./sq. mm.	Coefficient of Deviation per cent. from Mean B.L. ±
272 A -	Crepe mixed 25.5.23 by Operator X.	12	95	0.70	55.5
272 B -	Do. -	12	95	0.76	51.4
272 C -	Crepe mixed 25.5.23 by Operator Y.	8	95	0.74	69.1
272 D -	Do. -	8	95	1.20	17.0
272 E -	Do. -	8	95	0.95	57.5

Table 3 illustrates the variations in tensile strength which can occur in a series of vulcanised test pieces made from the same batch of crepe rubber from which portions are mixed on different days.

TABLE 3.

Sample.	Description.	Number of Tests.	Optimum time of Cure Minutes.	Mean Load at Break kgs./sq. mm.	Coefficient of Deviation per cent from Mean B./L. ±
360 A	Crepe Mixed 11.6.25 Vulcanised 12.6.25 Tested 13.6 25.	12	180	1.27	7.21
360 B	Crepe Treated exactly similar to 360 A.	12	180	1.26	8.28
360 C	Crepe Mixed 13.6.25 Vulcanised 15.6.25 Tested 16.6.25	12	180	1.40	4.55
360 E	Crepe Mixed 18.6.25 Vulcanised 19.6.25 Tested 22.6.25	12	180	1.32	9.7
279 A	Blanket Crepe Mixed 2.6.25 Vulcanised 6.6.25 Tested 8.6.25	8	165	1.23	13.8
279 B	Blanket Crepe from same stock. Treatment exactly as 279 A.	8	165	1.25	16.0
279 C	Similar to 279 A,B. Mixed 11.6.25 Vulcanised 13.6. 25.Tested 14.6.25	20	165	1.34	11.9
279 D	Similar to 279 A,B, C. Mixed 11.6.25. Vulcanised 19.6. 25. Tested 20.6. 25	24	165	1.07	49.5
288 Ac	Estate fast curing Crepe, specially prepared	16	50	1.12	28.3
288 As	Same Estate slow curing crepe. Normal preparation.	18	180	1.13	75.2

In the two samples 288 Ac and 288 As, it is of interest to note that notwithstanding the equality of Mean Breaking Load of the fast and the slow curing rubber the disparity of the coefficients of deviation is somewhat marked.

Effect of added Mineral Matter.

The effect of the presence of adventious mineral matter is illustrated by the figures recorded in Table 4. In Experiment 275, an attempt was made to imitate the type of contamination which would be likely to occur with particles of soil accidently introduced into latex at the time of tapping and collecting. The materials used were kieselguhr, precipitated silica, and Fuller's earth. The powdered material was treated as a filler and added to the rubber during the mixing with sulphur. The results obtained were as follows :—

TABLE 4.

Sample.	Description.	Number of Tests.	Optimum time of Cure Minutes.	Mean Load at Break kgs./sq. mm.	Coefficent of Deviation per cent from Mean B/L. ±
275 AC	Crepe plus 1 per cent kieselguhr -	10	165	1.12	11.6
275 AXC	Do. plus 2 per cent kieselguhr -	10	165	1.05	25.7
275 BC	Do. plus 1 per cent silica -	10	165	1.00	28.0
275 BXC	Do. plus 2 per cent silica -	10	165	1.02	15.6
275 CC	Do. plus 1 per cent Fuller's earth -	10	165	0.98	21.4
275 CXC	Do. plus 2 per cent Fuller's earth -	10	165	0.98	16.3
275 DC	Crepe Control -	10	165	0.98	17.3
275 EC	Crepe Control -	10	165	1.24	6.5
275 FC	Crepe Control -	10	165	1.19	7.8

The extra control mixings 275 EC and 275 FC were necessitated by the abnormality of the results obtained for mixing 275 DC.

The effect of soil particles on the variations in tensile strength of vulcanised rubber is shown by the results of two experiments in which washed soil fractions were macerated with the rubber-sulphur mix.

The soil fractions used were those obtained from the mechanical analysis of rubber estate soils. The fractions were ignited, washed, and dried to constant weight, before being mixed with the rubber.

The sizes of the particles were as follows:

Coarse Sand	...	0.2	millimeters diameter.
Fine Sand	...	0.04—0.2	,, ,,
Silt	...	0.01—0.04	,, ,,
Clay	...	Below 0.002	,, ,,

The Results obtained are given in Table 5.

TABLE 5.

Sample.	Description.	Number of Tests.	Optimum time of Cure Minutes.	Mean Load at Break kgs./sq. mm.	Coefficient of Deviation per cent from Mean B/L. ±
289 AC	Crepe plus 2 per cent *Coarse Sand*	8	165	1.13	7.8
289 ACR	Do.	8	165	1.17	5.9
289 BC	Crepe plus 2 per cent *Fine Sand*	8	165	1.16	6.9
289 BCR	Do.	8	165	1.23	7.0
289 CC	Crepe plus 2 per cent *Silt*	8	165	1.32	3.7
289 CCR	Do.	8	165	1.18	12.7
289 GC	Crepe plus 2 per cent *Clay*	6	150	0.82	11.5
289 EC	Crepe Control	8	165	1.17	9.0
289 ECR	Crepe Control Repeat	8	165	1.34	5.9
372 A	Crepe Control	18	180	1.29	9.2
372 B	Crepe plus 1 per cent *Clay* from Estate A	20	180	1.31	7.7
372 C	Crepe plus 2 per cent *Clay* from Estate A	20	180	1.21	11.3
372 D	Crepe plus 1 per cent *Silt* from Estate B	18	180	1.40	6.8
372 E	Crepe plus 1 per cent *Clay* from Estate B.	18	195	1.32	6.8

The difference in the rate of vulcanisation of samples 372 C & E is possibly accounted for by the fact that Estate A Clay has a pH value c 7.5 while the Estate B Clay has a pH value c 3.0.

Experiments on the addition of these two clays were continued. In one case the clay was added to the rubber on the mixing rolls; in the other case the clay was suspended

in water and added to latex (40 per cent Dry Rubber Content) before coagulation. In the latter instance it is possible that the weights of added mineral matter in the final rubber-sulphur mix are not absolutely exact, although the serum, after coagulation of the rubber, was perfectly clear in both cases, and the compounds are strictly comparable.

The results are given in Table 6.

TABLE 6.

Sample.	Description.	Number of Tests.	Optimum time of Cure Minutes.	Mean Load at Break kgs./sq. mm.	Coefficient of Deviation per cent. from Mean B/L. ±
372 F	Control Crepe -	22	180	1.31	8.47
372 G	Crepe plus 2 per cent *Clay* from Estate A -	16	185	1.32	5.83
372 H	Crepe plus 2 per cent *Clay* from Estate B -	18	225	1.23	4.78
372 L	Crepe Control Coagulated from Control Latex -	18	170	1.29	7.26
372 M	Crepe from Latex as above plus 10 grms *Clay* (Estate A) to 4000 ccs Latex -	17	165	1.38	5.43
372 N	Crepe from Latex as above plus 10 grms *Clay* (Estate B) to 4000 ccs Latex -	18	170	1 32	6.33

The conclusions to be drawn from the results given in Tables 4, 5 and 6 are that the presence of the added adventitious mineral matter has no specific effect on the fortuity with which the vulcanised rubber breaks under strain (4.) This indication is supported by a series of results obtained in a further experiment (No. 341.)

With the co-operation of the Senior Scientific Officer of the R.G.A. Laboratories, Petaling, and the Manager of Petaling Estate, an attempt was made to prepare abnormally clean smoked sheet and comparative smoked sheet containing an abnormal proportion of grit.

A one hundred gallon tank of bulked standardised latex, that is strained latex diluted to contain 1½ lbs. dry rubber per gallon, was allowed to stand for 30 minutes. The surface layer of the latex which contained black specks and particles of foreign matter was skimmed off completely ; the bulk of the 100 gallons in the tank was run out slowly from a tap placed six inches above the bottom of the tank. This latex was again strained through muslin into two duplicate Tanks A and B, and coagulated and machined to sheet in the usual manner.

The sheets were then smoked under muslin envelopes. Samples were selected for vulcanisation ; the sheet from tank A was labelled 341 A and that from the duplicate tank was labelled 341 B.

The residual six inches of settled latex, containing, presumably, the settled foreign matter, was gritty and dirty. It was coagulated by the addition of acetic acid in the ordinary manner. The coagulum was rolled and smoked without any precautions as to cleanliness. The finished rubber was labelled 341 YA_2.

The results of tests on these samples are given in Table 7.

TABLE 7.

Sample.	Description.	Number of Tests.	Optimum time of Cure Minutes.	Mean Load at Break kgs./sq. mm.	Coefficient of Deviation per cent. from Mean B'L. ±
341 A	Clean Sheet -	18	195	1.28	4.08
341 B	Duplicate Tank Clean Sheet -	18	195	1.26	8.27
† 341 YA_2	Dirty Sheet -	† 10	195	1.32	6.5

† *Note.*—The amount of dirty rubber from the sediment at the bottom of the tanks was insufficient for a greater number of tests. The duplicate sheet YB_2 was sent to the laboratory of the Research Association of British Rubber and Tyre Manufacturers.

As a continuation of this work it was decided to carry out further tests on rubber-sulphur mixes to which had been added a small percentage of the ground bark of the rubber tree ;—i.e. ordinary bark shavings obtained during tapping (5). The material was dried at 60°C, ground to pass through a 1/100″ mesh sieve and mixed with the rubber and sulphur on the mixing rolls.

The results obtained are recorded in Table 8.

TABLE 8.

Sample.	Description.	Number of Tests.	Optimum time of Cure Minutes.	Mean Load at Break kgs./sq. mm.	Coefficient of Deviation per cent from Mean B/L. ±
373 A	Crepe Control mixed and calendered 9.11.25 vulcanised 10.11.25 -	20	180	1.40	7.8
373 B	Crepe Control duplicate -	20	180	1.47	3.8
373 C	Crepe (A) mixed and calendered 14.11.25 vulcanised 15.11.25 -	20	180	1.38	3.8
373 D	Crepe (A), duplicate treatment as per 373 C -	20	180	1.38	14 6
373 E	Crepe (A) as above mixed and calendered 20.11.25 vulcanised 21.11.25 -	20	180	1.40	5.98
373 F	Crepe A treated as per 373 E, plus 2 per cent *Bark* mixed & calendered 20.11.25 vulcanised 21.11.25 -	20	180	1.05	5.67
373 G	Crepe A as for 373 A and B mixed and calendered 14.11.25 vulcanised 16.11.25 -	20	180	1.36	10.7

TABLE 8.—(*contd.*)

Sample.	Description.	Numbur of Tests.	Optimum time of Cure. Minutes.	Mean Load at Break kgs./sq. mm.	Coefficient of Deviation per cent from Mean P/L. ±
373 H	Crepe A duplicate of 373 G -	20	180	1.41	6.7
373 K	Crepe A treated as per 373 G and H, plus 2 per cent *added bark* mixed and calendered 14.11.25 vulcanised 16.11.25	21	180	1.23	5.04
373 L -	Crepe (A), plus 2 per cent *added bark* duplicate of 373 K -	22	180	1.20	5.46
373 R -	Crepe (A), mixed and calendered 20.11.25 vulcanised 23.11.25	22	180	1.38	11.59
373 S -	Crepe (A), duplicate of 373 R.	22	180	1.43	6.67
373 T -	Crepe (A) treated as 373 R and S plus 2 per cent *added bark* mixed and calendered 20.11.25 vulcanised 21.11.25 -	21	180	1.19	5.01
373 U -	Crepe (A), duplicate of 373 T.	21	180	1.19	6.8

An attempt was made to investigate further the effect caused by the addition of rubber bark. The possible presence of an active principle was investigated in a series of mixings containing extracted and unextracted fresh bark.

The results are given in Table 9.

TABLE 9.

Sample.		Description.	Number of Tests.	Optimum time of Cure Minutes.	Mean Load at Break kgs./sq. m.m.	Coefficient of Deviation per cent from Mean B.L. ±
375	A	Crepe (Control) -	1[illegible]	195	1.34	6.34
375	B	Crepe (Control) duplicate of A -	10	195	1.44	5.00
375	C	Crepe (375A) plus 2 per cent *dry bark* -	10	195	1.19	2.59
375	E	Crepe (375A) plus2 per cent *extracted dried bark* -	10	195	1.18	6.54
375	G	Crepe (375A) plus 1 per cent dry *extract from bark*	18	165	1.22	3 54
377	A	Crepe (Control) -	16	195	1 34	9.96
377	B	Crepe (Control) duplicate of A -	16	195	1.42	4.22
377	C	Crepe (377A) plus 2 per cent *dry unwashed bark* -	16	195	1.23	5.29
377	D	Duplicate of C -	16	195	1.19	4 86
377	E	Crepe (377A) plus 2 per cent *dry washed bark* -	15	195	1.22	3.92
377	F	Duplicate of E -	15	195	1.22	5.71

SUMMARY AND CONCLUSIONS.

The variations in breaking load (B/L) for standard crepe are normally under 10 per cent but the occurrence of much higher coefficients of deviation from the mean B/L is sufficiently frequent under ordinary circumstances to warrant further investigation as to the cause.

The addition of mineral particles from the soil, in the proportions recorded (Table 5), does not decrease the tensile strength,

neither does it cause any definite increase in the deviation from the mean breaking load, and in this respect our observations differ from those published by the Imperial Institute (4).

The reduced mean tensile strength of those samples which contain added bark (Table 8 and 9) is apparent, although there is no accentuated fortuity of break, as shown by the deviations from the mean breaking load.

It is evident from our investigations that the broblem of the variable tensile strength of plantation rubber is more involved than would appear to be the case from a superficial examination. The work already carried out by Whitby, De Vries, and at the Imperial Institute has opened the way to further investigations which will probably entail research into some of the fundamental properties of caoutchouc.

For example, the different results which were obtained here and at the Imperial Institute on the effects of adding sand to rubber are probably only to be explained by some characteristic of the rubber which, in our present limited state of knowledge has been omitted from our consideration.

The only deductions which can be drawn from the results recorded above is that variations in the tensile strength of plantation rubber are not entirely fortuitous and do not depend upon what is generally described as dirt in rubber, and the problem requires further investigation.

De Vries and Spoon (6) in their observations on results obtained at the Central Rubber Station, Buitenzorg, from a long series of investigations on the variability of plantation rubber, conclude with the significant words : "The usual variations in methods of preparation do not change the tensile strength and it appears clearly that the trust, that a good colour and pretty appearance also guarantee a product of superior quality, can sometimes result in deception," and further (7) "This variability in tensile strength deserves the more attention as low quality in this respect cannot be remedied, the rubber is inferior without a hope of redress."

Shortcomings in rate of cure can be remedied, but shortcomings in tensile strength are so far an unalterable defect and therefore it appears to us to be a matter of importance to investigate the cause.

1. Whitby Plantation Rubber p.325. et seq.
2. De Vries Archief v. d. Rubber Cultuur 1922, No. 8 p. 301.
3. De Vries „ „ „ „ „ 1921, No. 3.
4. Bulletin Imperial Institute 1920. Vol. XVIII p. 10.
5. „ „ „ 1920, Vol. XVIII p. 8.
6. De Vries Archies v. d. Rubber Cultuur 1919, No. 6 p. 252 (Dutch Text.)
7. De Vries „ „ „ „ „

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DISEASES OF COCONUT PALMS.

A. Sharples.

THE present position of the problem of Palm Diseases is much advanced compared with the position some six years back. Even to-day the position is not altogether clear, but the main cause of the past obscurity has been fairly well eliminated and as a result, investigators on Palm diseases can get at close grips with the varied symptoms which have to be connected up with definite causes. The study of Palm diseases is of the utmost importance in connection with the development of Malayan Oil-Palm plantations; it is the writer's intention to give a resume of the diverse diseases which have claimed notice in Malaya, at the same time calling attention to the important researches made in other countries.

Bud-Rot of Coconut Palms.

All planters interested in Palm cultivation have come in contact with "Bud-Rot". "Bud-Rot" is a classical instance of an epidemic disease and some writers state that "Bud-Rot" attacks have been so severe in many places that Coconut palm growing has been practically destroyed. The cause of Coconut Bud-Rot, after the investigations of Johnson (2) in the West Indies was attributed to *Bacillus coli* (Escherlich, Migula). Later investigations in India by Butler (1) proved that *Phytophthora palmivora* caused a Bud-Rot of Palmyra palms (*Borassus flabellifer* Linn.); this work was followed up by Shaw and Sundaraman (6) who obtained evidence which led them to the conclusion that *P. palmivora* was the cause of Bud-Rot in Coconut palms; Reinking (4) in the Phillipines came to a similar conclusion, but considered the causal fungus to be *Phytophthora faberi*. The work in India has been followed up and Mc. Rae (3) published a striking article giving the methods and results of the work of the Indian investigators over a period of many years. The conclusions and methods of organising the control work are so interesting as to justify the reprinting of portions of the article.

The position with reference to the Bud-Rot problem in the Eastern Hemisphere has now been soundly stated; investigators in the West Indies, i.e. Ashby, Nowell and others, have followed up the lines indicated and shown that *Phytophthora Palmivora* Butl. is commonly associated with Bud-Rot of Coconut Palms; the position from practically all the large Coconut growing countries has been stabilised and *Phytophthora palmivora* Butl. or some closely related species must be considered the cause of Coconut Bud-Rot.

It should be mentioned that to the layman "Bud-Rot" is a very comprehensive term, for any cause interfering with vital processes usually lays the Bud open to attack, without the necessary entry of *P. palmivora*; in the writer's opinion there is no doubt that, in the past, many symptoms have been dubbed "Bud-Rot" without due consideration. The position is better understood to-day, and investigators are aware that all obscure symptoms cannot be assigned to "Bud-Rot", simply because the central leaves fall out easily with an accompanying putrefaction of the bud tissue.

Mc. Rae's publication mentioned above is divided into two parts; Part I details operations undertaken to combat the spread of Bud-Rot on Palmyra palms (*Borassus flabellifer*); Part II includes inoculation experiments which prove definitely that Coconut palms can be attacked by *P. palmivora* Butl.

The clear exposition of the work carried out in India enables one to judge the position in Malaya much more accurately. Mc.-Rae proves that although "Bud-Rot" of Palmyra Palms is a serious epidemic disease it can be controlled by symtomatic measures; that comparatively, Coconut palms, in a badly infected area of Palmyra palms, show relative freedom from the disease. The relative freedom of Coconut palms with regard to attacks of *P. palmivora*, as compared with Palmyra palms is ascribed to (a) structural differences (b) less handling of the palms. With reference to the latter, Palmyra Palms in India are largely used for toddy gathering; in Malaya Coconut palms are used exclusively for this purpose, yet there is little difference in this country as regards amount of Bud-Rot to be found on palms used for toddy gathering, and those from which nuts are gathered for Copra. Structural differences are undoubtedly of large significance, as regards comparative freedom of Coconut Palms.

The writer (2) criticising the value of evidence published in papers on 'Bud-Rot' stated as regards the cause in India "that *P. palmivora* might be assumed to be the deciding factor in any epidemic of "Bud-Rot" though this must be proved by inoculations on mature trees." In this respect the publication by Mc.-Rae is complete, and no further doubt can exist as to the primary factor which has to be controlled in Bud-Rot epidemics.

The position in Malaya can be gauged from Mc.-Rae's statements—"On Palmyra palms in India "Bud-Rot" is a serious epidemic disease which spreads slowly but can be controlled by systematic measures. Coconut Palms, in districts where the causal fungus is present, are relatively free from attacks by the fungus." These conclusions lead to the position that in Malaya "Bud-Rot" of Palms need not be considered a great menace to Coconut and African Oil Palm cultivation, as has been usually understood previously.

As pointed out in (2) the writer is fairly certain that most of the so-called Bud-Rot in Malayan plantations can be ascribed to agencies other than attacks by *P. palmivora*. This is well seen on Mature African Oil Palms; on these palms some form of "Bud-Rot" is common, but the palms practically always recover. Over a period of three years there has only been one casualty, the rot travelling down the stem and so preventing the ascent of water. In previous years several groups of mature trees were taken out annually and destroyed.

With reference to the systematic position of the presumably different *Phytophthora* species suggested as the cause of Bud-Rot of Coconuts, Rorking (4) considered *P. faberi*. Maublanc, as the cause; in 1924 C. M. Tucker at the Porto Rico Agricultural Station considers this infectious disease as caused by a fungus which has been described as a strain of *P. faberi*. Maublanc. Recently the writer had

the opportunity of meeting Dr. Reinking who, in turn, had been in communication with Dr. Butler. The conclusion has now been reached that the fungus named *P. palmivora* by Dr. Butler, and that isolated from Bud-Rot in the Phillippines and considered by Dr. Reinking as *P. faberi* are practically identical, so that there is a common cause for "Bud-Rot" in both Eastern and Western Hemispheres.

The following general review of the operations in India is extracted from Mc. Rae's article.

General Review of the Operations (in India)

(a) *The Numbers.* The earliest attempt in 1906 to deal with the disease over a limited area accounted for 40,000 dead palms. The number of dead palms cut during the 19 months, June 1907 to December 1908, viz, 398,000 included many trees that had died from about June 1904 because it takes up to three years for all the leaves to wither, reckoning from the time the growing-point dies and the topmost leaf has withered. Consequently a considerable number of such cases would still be standing and be dealt with by the staff as they moved over the infected area. As mentioned on page 47, the intensity of the disease was greatest in 1908 when probably about 100,000 died, even though 183,000 were actually cut that year, the excess being cases that had died in the years immediately preceding. From 1908 to 1913 there was not much of a fall in the annual figures this being due to the gradual perfecting of the operations, to trees being cut more promptly and to the area being better patrolled. From 1914 to 1917 there was a steady fall in the number of outwardly diseased and dead trees owing to the fact of 74,800 inwardly infected trees having been dealt with and cured. 1918 was a disappointing year because the number suddenly rose in all categories. However, there was a considerable fall in 1919. In 1920 the Pest Act was applied and the numbers again fell both in that year and in 1921 the last year of the operations under review. From 1913 onwards 100,000 diseased trees in the early stages of infection had the diseased tissue removed and were restored to health during the examination of 2,800,000 apparently healthy palms growing in the vicinity of dead ones, and there can be no doubt that this had a great influence in quickly reducing the number of dead palms in the later years of the operations.

(b) *The area.* The area said to have been infected in the earlier years was given by Dr. Butler for August 1905[1] and for the end of 1908[2], and in a report to Government I gave the known infected area about the middle of 1910. The diagram shows in colour the different areas which were about 500,1,200, and 1,800 square miles respectively. The extension in the northern part is fairly accurate but that towards the Kistna is inadequate in all three estimates. The information in the earlier estimates was got chiefly by a young member of the Agricultural Department whose home was

1. Butler. E. J. Agri. Jonr. India, Vol. I pl, XX, p. 305.
2. Butler E. J. l. c.

in the Godavari delta, and it is likely that he had more detailed information about the Godavari where his home and his work were than about the Kistna District. The people in Tanuku and Narasapur Taluqs say they noticed it in 1903, the year of the cyclone, but the people beyond the Narasapur canal had no reason to report the presence of disease in those early days, thus it could only be located by actually seeing it and there was little or no touring done in the Kistna District before 1910 with the object of finding the extension of the disease. With later more accurate and detailed knowledge of the disease in this locality it seems more than probable that long before 1905 the disease had already crossed the Vasishta branch of the river, and that it had extended further into Kistna District by 1908 or by 1910 than is shown in the map. Early in 1910 cuttings were being made in Bunder Taluq around Masulipatam and from observations on the dead palms there I am certain the disease had been there for over three years before this date. Yet at the end of 1908 the disease had not been reported, nor was it known to exist there, by members of the Department. In 1910 there were only two infected localities known between Masulipatam and the infected area in Narasapur and Tanuku Taluqs adjacent to the main infected area in Godavari District viz., Gudivada near the former area and Kaikalur near the latter. Hence I was inclined to think that the disease had been carried to Masulipatam by sea by human agency, (as printed) which of course was quite possible. Subsequent information got by the Special Deputy Collector and Tahsildar, by one of my assistants and myself in extensive tours have led me to think that this explanation is unnecessary and that the disease could have travelled overland from the Godavari area. Granted that Kistna was infected earlier than was at first thought, and this seems very likely, the overland extension is quite feasible and in conformity with the facts of the then better known extension northwards in Godavari. The boundaries of the infected area about the end of 1912 enclosed a total area of about 4,000 square miles and with the exception of two small extensions along the coast at the extreme ends, comprise the limits of the infected area. Beyond the railway line from Rajamundry to Samalkota and Cocanada the land is not irrigated but is upland dry land of a slightly undulating nature. Here the extension has been slow and the disease has generally occured in the shallow depressions. From quite early in the operations efforts have been made to banish it from this tract and with success. It is now confined to two small tracts near the railway line and one further up the coast. In one of the former round Rajamundry the disease is of long standing and is still intense. This has come about because the tree-owners there have all along been difficult to persuade to do anything or allow anything to be done, but the stimulus of the Pest Act will no doubt have the desired effect. The tract Peddapur consists of two very small areas where very few diseased trees are found now. The tract along the coast in Tuni Division comprised parts of two villages in 1914 but later was found to extend to eight. It was outside the area patrolled and had the disease for some time before it was discovered, but work is being concentrated on it now. Beyond the railway line from Rajamundry to Bezwada the disease, so far as is known, has not appeared except in a few villages on the right banks of the Godavari river once believed

to be free but now known to be still infected. It has actually reached Bezwada and Ellore halfway between the two as an extension from the delta. The Kistna river is the boundary on the west side except for two small areas near Repalle and Tenali which were discovered in 1920 beyond the patrolled area. They are now being dealt with thoroughly.

(c) *Intensity of the disease.*—The Kistna area was never so intensely infected as the Godavari one, with the exception of those parts of Tanuku and Narasapur Taluqs between the Narasapur canal and the Vasishta branch of the river, and has been more amenable to treatment by the operations. The disease is in several isolated areas and is nowhere severe except perhaps comparatively so in the river-side villages. Though not to the same extent as in Kistna the disease has disappeared throughout the Godavari District from many places where it once existed, and there are still five areas in which it is severe though nothing like to the same extent as formerly, viz., around Rajamundry, Mundapeta, Karapa, Vemavaram and Kottapeta. In general the disease has been pushed out and kept out of the uplands around the deltas except to a short distance on the banks of the Godavari river and in two other small areas, while in the deltas it has been thinned out especially towards the Kistna side and reduced in intensity.

(d) *The Cost.*—The total expenditure in connection with the operations from 1906 to 1921 has been in round figures three lakhs of rupees or £20,000.

Results of the Operations.

As in every fight against a disease it is well nigh impossible to make a complete estimate in figures of the good that has accrued, for besides the definite arithmetical value that can be put on the individuals that have been cured, there remains the value of those that have escaped taking the infection because of the protection given them through the preventive measures, and any estimate of this value is more or less speculative. The capital cost of a palmyra in the deltas is about two rupees on the average. The benefits of the operations may be stated under four heads. (a) The value of the palms that have been cured, taking the number at a conservative estimate at 90 per cent. of 231,631 "inwardly" and "outwardly" infected palms operated on, is 417,000 rupees. (b) In 1907 and 1908 the number of dead palms cut includes the accumulation of several years, but in 1909 the bulk of the old standing cases had been removed and the operations would have had some little effect in reducing the yearly number of dead palms, so 100,000 may be taken as representing the maximum intensity of the disease in 1908. Now if the disease had continued steadily at that intensity then in the 15 years of the operations 1,500,000 palms would have died. But during that time 758,000 died, so it can be said with confidence that 742,000 have been saved from infection and these represent a value of 1,484,000 rupees. (c) Again from the number of dead palms that were cut in 1907 and 1908 (398,000) it is clear that the intensity of the disease had been increasing rapidly since 1890 when it was first noticed and

there was no reason against its going on as rapidly to increase in the next 13 years. Besides, from an analysis of the figures from June 1907 when the operations began to the end of 1908, together with the knowledge that an interval of three and half years may elapse between the death of the growing-point and the withering of all the leaves of the crown, and that the disease arose to epidemic dimensions from a definite place in the Godavari delta about the year 1890, we can assume a simple progression in the rate of increase then the figures for

1908 would be	100,000
1907	94,000
1906	88,000
1905	82,000
and for half of 1904	38,000
	402,000

the total of which is very near the figure for those actually cut viz., 398,000. At the same rate of progression for the next 13 years the figures for dead trees would be about 1,790,000 multiplied by some factor comparable to 100,000, the number of dead trees in the beginning of the period of 13 years under consideration. Of course, the actual number is purely speculative, but it does show the nature of the proportions to which the disease was approaching. The prevention of the disease in this case has a potential value that cannot be accurately estimated in money. (d) In conclusion, we can affirm definitely that the disease has been reduced from a grave menace (100,000 in 1908) to a controllable factor (8700 in 1921).

Though the disease has been greatly reduced it is still dangerous and requires to be treated with caution. So many times has it been found, more especially in the earlier years, that when a village was put out of the sphere of operation after it had shown no diseased trees for one year, and sometimes too in later years, after an interval of two or three years the disease appeared again, sometimes because of re-infection from outside but undoubtedly also from the appearance of a small number of cases in which the fungus had been developing slowly, consequently the disease had appeared after a longer period than usual and had again started a nucleus of infection that spread the disease to surrounding trees requiring the village to be brought under the operations once more. Hence the operations under the Pest Act will have to be continued for some years longer (1) to reduce still further the amount of disease and (2) to deal thoroughly and expeditiously with the three or four small outbreaks that have occured beyond the hitherto patrolled infected area.

It was the influence the Collectors of the two districts and their subordinate officers had with the people that made it possible for these irksome operations to be carried on, the members of the special staff being recruited wholly from the revenue branch of the district administration. For years there was no legal compulsion behind the staff and the only authoritative backing it had till 1919

was the order of the Collectors to the village officers to attend to this work. (Naturally it was Government in the first instance that decreed the operations, provided the funds for the special staff, and decided on the continuance of the work. But I am referring just now only to the actual working of the operations in the districts.) The revenue inspectors could not legally compel anyone to cut diseased trees, nor had they the right to enter on anyone's land and cut diseased trees. Everything had to be done with the acquiescence and the co-operation of the people, and naturally it took a considerable time to get them to agree at first to allow the work of cutting to be carried on at Government expense and then gradually at there own expense, especially as for some years there was no very apparent good result and as they believed the disease to be the scourge of a malign deity which there was little use trying to escape. It reflects credit on the members of the staff that they did so much for so long without any person's taking proceedings against them, and again that the people have been induced to carry on the work during the last two years under the Pest Act with only one prosecution. That the credit for carrying on the operations against this disease with the measure of success achieved is due to the special staff under the direction of the Collectors of the two districts is freely acknowledged. The Agricultural Department's activities consisted in elucidating the life-history of the fungus, devising and improving methods of combating the disease, and giving encouragement.

During 1917, 1918 and 1919 the general examination went on during the dry months and the number of diseased palms decreased except in 1918 when it suddenly increased. This was a bitter disappointment. Even though there had been a series of unusually wet years we hoped that the operations now had a greater influence on the disease than natural conditions. In Kistna District the disease appeared again in thirty-seven villages that had been given over to the supervision of the ordinary revenue staff in 1912, and in twenty-one other villages in Bhimavaram, Kaikalur and Gudivada, and a few stray cases were cut at Bezwada, Ellore and Masulipatam, while in Godavari District a few cases were cut in Pelavaram. This shows the insidious character of the disease and how difficult it is to eradicate entirely from a village. From March 1918, when the number of infected trees were greatest, a special effort was made to get the disease again under control, and the general examination in 1919, when the staff tried to find every diseased tree, showed that the number had fallen again to previous proportions. In December 1919 and January 1920 my assistant Mr. Sundararaman and I toured by separate routes through the worst infected villages of both districts. Altogether we saw under thirty dead or outwardly infected palmyras even though operations had been suspended for the previous two months. In former years during December and January there had always been a large number of diseased palms and we expected to see several hundred. That so small a number of diseased trees was found on this tour of inspection was very encouraging and was an undoubted proof of the success of the operations.

From November 1919 to March 1920 the operations were suspended at the instance of the Director of Agriculture in order that

the staff might carry on a campaign of publicity before the application of the Pest Act to the disease. It was in connection with the attempt to have outwardly infected trees dealt with that we first suggested early in 1912 to take legislative power to cut compulsorily such trees, but the Government declined to resort to compulsion till the need for it was much more clearly established. The operations went on accordingly relying on the tact and persuasiveness of the members of the special staff to overcome the difficulties. That they were successful in great measure has been shown in the discussion of the position of the operations from year to year, but they never induced any great body of the tree-owners to do the work spontaneously though they did persuade them to allow the cutting to be done at their (the tree-owner's) expense. By 1919 a definite proposal for a local Pest Act was accepted by the Government of Madras, and at a special meeting at Pusa, where the subject was discussed, the last objection to such an act was withdrawn and the way was finally opened for having it passed. Throughout the whole period of the operations there was one hope that never was realized to any great extent—the hope of interesting the tree-owners in the measures taken to combat the disease to such an extent as to get them to act for themselves. Had this hope been realized the special staff might have been withdrawn gradually and the people left to protect themselves against the loss from the disease. Most people in the infected area know about the disease and its symptoms but entirely depended on the official staff to deal with it. The next step was to stir up this interest. By the application of the Pest Act of 1919, dealing with diseased palmyras became a duty, and it seemed not unreasonable to believe that after people got accustomed to tackling the disease themselves they would come to realize that they could fight it without extraneous help. To ensure that every person in the infected area and around it did know sufficient about the methods of dealing with diseased trees, his duties under the Act and the penalties for non-compliance, the special staff stopped the operation and devoted themselves to a publicity campaign. The fact of the operations being entirely stopped for four months seemed to have impressed the people that Government was in earnest. Pamphlets in the vernacular were written with illustrations given in colour and distributed to all the literate people directly and indirectly connected with the villages and small posters with an illustration of a diseased palmyra palm were posted in thousands on conspicous places. To reach the great bulk of the tree-owners, who were illiterate, meetings were held in the villages where "sandwichmen" were sent round by day and lantern demonstrations were given by night. Verses were written and folksongs adapted and they were sung at festivals and fairs and mask dances were also a feature. Everything possible was done to excite interest and there is no doubt of the success of the campaign, and the credit is in great measure due to the energy and fertile brain of M. R. Ry. Rao Sahib, V. Bhogappayya Sastry Garu, B A,, Special Deputy Collector on Palm Duty in Godavari and Kistna Districts.

In 1921 when the complete operations were being carried on with the additional stimulus of the Pest Act, the number of diseased trees found remained low, being 16,500 in 1929 and 8,700 in 1921.

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"A CONTRIBUTION TOWARDS OUR KNOWLEDGE OF THE ALEYRODIDAE OF CEYLON."

IN this paper Mr. G. H. Corbett has placed on record his examination of Mr. E. E. Green's collection of the Aleyrodids of Ceylon when working at the British Museum last year. The collection which consisted of twenty-nine species has been listed together with other previously described species in the Bulletin of Entomological Research, Vol. XVI, Pt. 3, Jan. 1926. Of the twenty-nine species, two genera and nineteen species new to science are described.

As this group is an important economic one and some of the species, if not all, are common both to Ceylon and Malaya and the Bulletin of Entomological Research does not reach our readers in Malaya, it is considered advisable to reprint the paper in this Journal in the hope that interest will be aroused and specimens of this little-known group of insects in Malaya will be forwarded to the Department to promote further studies.

It might be mentioned that Aleyrodids are generally inconspicuous on the leaves of plants, but some are made evident by a waxy secretion. For example, *Aleurodicus destructor* is rendered prominent on the leaves of coconuts by copious long white waxy filaments.

Genus **Aleurodicus**, Douglas.

Aleurodicus, Douglas, Ent. Mo. Mag (2) 3, 1892, p.32.

Aleurodicus holmesii, Maskell,

Aleyrodes holmesii, Maskell, Trans. N. Z. Inst. xxviii, 1895, p. 435.

Aleurodicus holmesii, Maskell, Ckll, Fla. Agr. Exp. Stn. Bull. 67 1903, p. 644.

This insect was originally recorded from Fiji on *Psidium* sp. and later by Woglum from the Botanic Garden, Buitenzorg, Java, on a plant of the family Sapindaceae. Green's specimens were collected on an unknown plant at Kandy, i. 1910.

Short, brittle, glassy wax rods occur with the pupa-cases on the upper surface of the leaf.

Aleurodicus antidesmae, sp. n.

Pupa dirty white in colour, raised on a vertical rim composed of white wax deflexed from possibly small wax pores on the margin of the case and surrounded by rather short, brittle, glassy wax rods produced by the compound wax-pores. Length 1.29 mm., breadth 0.65 mm.; sub-ovate in shape. Margin dentate, with about 62 pairs of teeth and a pair of small spines latero-posteriorly. Wax-pores at

the margin are not evident. Mid-thoracic and transverse sutures distinct. Abdominal segments differentiated. Subdorsal area with five equal pairs of large compound pores—one anteriorly on the cephalo-thorax and four pairs on the abdomen; each pore armed with a strong spine. Vasiform orifice subcordate; operculum twice as long as broad and about half-filling the orifice; posterior margin sinuate, with a pore of short setae; lingula large, setose, exserted, spatulate, narrowing at the base, with two pairs of spines at distal end.

Pundaluoya, on *Antidesma bunius (E. E. Green.)*

This species has been described from only one specimen which was situated near the mid-rib on the lower surface of the leaf.

Genus **Dialeurodes**, Cockerell.

Dialeurodes, Ckll., Proc. Acad. Nat. Sci. Phil. 1902, p. 280 Quaintance and Baker, Bur. Ent. U. S. Dept. Agr., Tech. Ser. Bull 27, pt. 2, 1914, p. 97.

Dialeurodes, radiipunctata, Quaintance and Baker.

D. (*Dialeurodes*) *radiipunctata*, Q. and B., Pro. U. S. Nat. Mus. i, 1917, p. 418.

This species was described from material sent by Rutherford and collected on *Memecylon* sp., Peradeniya, 10. xi. 1913.

Dialeurodes (Rabdostigma) radiilinealis, Q. and B.

Dialeurodes radiilinealis, Q. and B., Proc. U. S. Nat. Mus. li, p. 436.

The pits on the lower surface of the leaves are shallow and make little impression on the upper surface. *D.* (*Rabdostigma*) *loranthi* causes much deeper pits, producing a galled effect on the upper surface of the leaf. It should be mentioned that the dorsum of all the species which I have examined shows a marked tessellation and carries very minute spines. Dr. C. D. Baker informed me that of his material only the parasitised individuals have a tessellated dorsum. I refrain from making a new species until I have examined more material. This Aleyrodid was originally described from material collected by Marlatt on mistletoe at Nuwara Eliya, 26. i, 1902. Green's specimens were collected on the same plant at Peradeniya, vi, 1910.

Dialeurodes (Rabdostigma) loranthi, sp. n.

Pupa yellowish, subcircular, no secretion of wax evident, situated on lower surface of leaf, generally sunk in large, deep depressions; length, 1.23 mm.; breadth, 1.05 mm. Margin crenulated; sutures running in from margin conspicuous, more distinct than in *D. radiilinealis* and wavy for about 0.068 mm.; in subdorsal area these give place to polygonal markings which decrease

in size towards mid-dorsal line. Derm with a tessellated appearance. Transverse suture bending sharply forward and then curving inwards to meet the corresponding half of the other side mid-dorsally; two other transverse sutures present dividing this demarcated area on cephalo-thorax into three transverse areas—not so marked in *D. radiilinealis*. Abdominal segments slightly differentiated. Tracheal pores situated at a slight distance from margin and encircled by a ring of teeth, the exact number of which it is difficult to distinguish. No caudal pore present. On anterior and posterior lateral margins there is a pair of small spines. Vasiform orifice subcordate; operculum similar and obscuring the lingula.

Hewaheta, viii, 1910, on *Loranthus* (*E. E. Green*).

This species causes deep pitting of the lower surface of the leaf.

Dialeurodes (Rhachisphora) rutherfordi, Quaintance and Baker.

Dialeurodes rutherfordi, Q. and B., Proc. U.S. Nat Mus., li, p. 432.

Peradeniya, 1913, on leaves of *Loranthus* (*Rutherford*).

Dialeurodes (Rhachisphora) trilobitoides, Quaintance and Baker.

Dialeurodes trilobitoides, Q. and B., Proc. U.S. Nat. Mus., li, p. 433.

Peradeniya, on an unknown plant (*Woglum,*) on *Harpullia* sp. and on *Eugenia operculata* in 1913 (*Rutherford*).

This would appear to be one of the most common and readily seen Aleyrodids in Ceylon, since in Green's collection of some 43 packets it occurred nine times. The pupa is made conspicuous by having white wax on the mid-dorsal ridge and on the ridges running towards the margin. Green's collection does not to any large extent augment our knowledge of the host-plants. He collected this insect on an unknown plant at Neboda, ii, 1895; at Tangalla, vi. 1894; at Batticaloa, v. 1906; at Sigiriya, viii. 1909; at Haragama, ii. 1908; at Trincomali, ix. 1910; at an unrecorded place, vi. 1906; on *Memecylon* sp. at Kesbewa, iv. 1903; and at Maha Illupalawa, North Coast Province, ix. 1905.

Dialeurodes (Rhachisphora) capitatis, sp. n.

Pupa on leaf whitish and made conspicuous by the wax secretion, which is exuded in the nature of columnar glassy rods from the dorsal papillae. Length, 1·48 mm.; breadth, 1·05 mm.; ovate, margin slightly and irregularly crenulate. Abdominal segments distinct, giving the appearance of a rhachis. Tracheal and caudal pores distinct, crenulations in these areas slightly more definite. With the exception of the pairs of setose spines on the latero-posterior and the posterior margins, there are about 12 pairs of submarginal,

slightly vasiform spines extending about half their length beyond the margin. A row of capitate spines arise just interior do the submarginal spines and do not for the most part extend beyond the margin. There are 4—5 rows of these capitate spines throughout the dorsum of the pupa-case; the rows nearest the dorsal area being the smallest. Each abdominal segment is armed with a pair of these large papillae. Vasiform orifice subcircular with a conspicuous notch at distal end; operculum about half filling the orifice, exposing the lingula, which is setose and would appear to be ringed with fine hairs.

Nuwara Eliya, iii. 1921, on an undetermined plant (*E. E. Green*).

Dialeurodes (Rhachisphora) setulosa, sp. n.

Pupa on leaf stramineous or light brown, but of a deeper brown mid-dorsally, no waxy secretion visible; elliptical; length, 1.64 mm.; breadth, 1.17. Margin crenulate, sutures evident in sulmarginal area; eleven pairs of inconspicuous vasiform spines in submarginal area, the apices of which do no not extend beyond the margin; a pair of longer spines on anterior lateral margin and on margin posterior to the vasiform orifice. Thoracic folds ending in circular pores armed with a sinus of teeth, a short distance in from the margin. Caudal fold with, on either side, a narrow band densely crowded with brownish polygonal areolations. (Termination of caudal fold cannot be discerned in slide). Rhachis very prominent, brown in colour, mid-dorsal area crowded with small polygonal markings which gradually disappear laterally; transparent dorsally; abdominal segments distinct and bearing pores. In cephalo-thoracic region small pores and spathulate spines evident, together with polygonal markings. Anterior end of rhachis coneshaped. Subdorsal area covered with numerous scabrous spines, and folds from abdominal sutures distinct

Haberane, on an unknown plant, viii. 1909 (*E. E. Green*).

Dialeurodes (Dialeuropora) decempunctata, Quaintance & Baker.

Dialeurodes decempunctata, Q. & B., Proc. U. S. Nat. Mus. li., p. 434.

Peradeniya, on cinnamon, x. 1910; and Lahore, India, on mulberry (*R. S. Woglum*).

Genus **Aleuroplatus,** Quaintance & Baker.

Aleuroplatus, Q. & B., Bur. Ent. U. S. Dept. Agr., Tech. Ser. 27, pt. 2, 1914, p. 98.

Aleuroplatus (Aleuroplatus) incisus, Q. & B., Proc. U. S. Nat, Mus. li., p. 358.

Peradeniya, on *Ostodes zeylanica*, x. 1910 (*R. S. Woglum*); and on *Garcinia specta*, ix. 1913 (*A. Rutherford*); at Harputalo, 5,000 ft., xii. 1914, on an unidentified plant (*E. E. Green*).

Aleuroplatus (Aleuroplatus) ficus-gibbosae, sp. n.

Pupa situated on upper surface of leaf, dark brown to black, with no wax fringe; length 0·98 mm., breadth 0·71 mm.; ovate, margin dentate, seemingly double and depressed at the thoracic and caudal folds. Folds not evident, but the teeth prominent, about 9 in number, middle ones largest. Subdorsal area with an irregular row of pores running right round the pupa-case, and in submarginal area another row, which is not so distinct; between those two rows, other rows of smaller pores are present; pairs of small spines situated on the latero-anterior and latero-posterior margins, another pair near the mid-thoracic suture (about mid-way between the anterior margin and transverse suture), another just in front of the vasiform orifice, and a third posteriorly near the margin. The transverse suture turns slightly forward anteriorly and is distinct. Abdominal segments distinct in mid-dorsal region; thickenings on sutures evident. Vasiform orifice elevated, subcordate in shape and toothed on inner posterior and lateral margins; operculum about half-filling the orifice and similar to it in shape.

Peradeniya, i. 1905, on *Ficus gibbosae* (*E. E. Green.*)

Aleuroplatus (Orchamus) premnae, sp. n.

Pupae found on lower surface of leaf of host-plant. Colour varying from transparent to light brown, median line always yellow; no wax fringe discernible; length 0.94 mm., breadth 0·82 mm. Pupa-case subovate in shape, anterior margin slightly pointed. Median ridge prominent, especially in cephalothoracic region; margin with a double row of teeth, the outer row simply dentate, the inner row slightly capitate. Teeth of thoracic and caudal folds not conspicuously larger than the marginal ones, the folds themselves not evident. Marginal rim differentiated. Conspicuous simple pores present and generally distributed throughout dorsum except on marginal area. Suture separating submarginal and subdorsal area absent. Rhachis present, but not strongly developed; transverse sutures faintly developed towards margin. Pores on abdominal segments. Vasiform orifice small, subcordate, with inner and lateral margins toothed; operculum half-filling orifice and of similar shape; lingula setulose. Anterior and posterior lateral margins each with one pair of spines, three pairs on anterior portion of case; vasiform orifice surrounded by three pairs of spines, a fronto-lateral, a lateral, and a posterior pair.

Peradeniya, on *Premna cordifolia* (*E. E. Green.*)

This species is readily distinguished from other members of the same subgenus by the pore system.

(*To be continued.*)

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MARKETING OF DERRIS (TUBA ROOT)

D. H. Grist.

AN investigation of the possibilities of marketing tuba, the best form of preparation, and the likelihood of a steady market for the produce was considered advisable in view of the attention which many planters have given to its cultivation.

Tuba is the essential ingredient in several proprietary insecticides, and in 19 1 one firm patented various claims for the use of the root. There are at present three large firms using tuba, and various sheep dips and sprays have been placed on the market, the efficiency of which depends upon tuba root. Other firms, and also several scientists, are investigating the use of tuba in other directions. In particular may be mentioned that interest in the value of tuba root as an insecticide has been stimulated in Australia by the increase in popularity of a certain brand of sheep dipping paste which contains tuba root extract. In Nova Scotia experiments are being conducted with tuba against a large number of varieties of fruit pests. Investigations in other directions may open up new markets, but for the present, there is no doubt that active interest in tuba is confined to only a few firms.

Source of Supply.

The bulk of supplies of the root came from the Malay Archipelago, mostly from Borneo, where buyers can almost invariably buy much cheaper from native growers than they can from estates in the Federated Malay States and elsewhere.

At the end of 1925, 500 acres were under this form of cultivation in the Federated Malay States and 600 acres in Johore.

Market Price.

There has been considerable divergence of opinion as between seller and buyer regarding the value of this product. Sellers have demanded prices of approximately one shilling per lb., whereas buyers are not prepared to advance the price in Singapore beyond five pence to six pence per lb. At about the latter price business can generally be effected. Undoubtedly buyers are influenced by the fact that they can obtain supplies at their offer, which may or may not be remunerative to the estate producer, but pays the native grower. Growers should remember that the present conditions of preparation of the root for the market entail a freight charge to England of nearly £20 per ton, and furthermore they are in no position to guarantee the toxicity of their consignment. The freight charges to Melbourne are much less and an effort is therefore being made to encourage interest in Australia.

Preparation of Root for Market.

As mentioned above, the two main difficulties in marketing tuba are :—(a) lack of knowledge of its toxic value and (b) excessive cost of shipment.

The best variety to grow is generally stated to be "tuba merah," and "rimba" but what exactly (botanically) "tuba merah" and "rimba" mean is uncertain. The varieties are being investigated by the Department of Agriculture and, after identification, it will become possible to compare the toxic content of the varieties.

Methods to reduce bulk for shipment are of urgent necessity. Attempts to press the root before baling have not proved very satisfactory. Chopping up the root reduces its bulk to some extent, but not sufficiently. Grinding the root and then pressing into bales seems to give the best results; this method has been used in two factories in Malaya.

The suggestion that the toxic principle might be extracted by solvents awaits further investigation. The opinion is expressed that this method lowers the toxicity.

It is regretted that at present, evidence on many of these points cannot be proved by figures.

Difficulty has also arisen on account of tuba root exported being found to contain borers which not only eat the root but destroy its toxic qualities. In view of this, fumigation of tuba before export will probably prove necessary.

Conclusion.

The cultivation of tuba will show no advance in Malaya until the difficulties attending the selection of the best varieties and reduction of freight are overcome. The solution of these points would probably open up a larger market. Fumigation before shipment is also considered necessary, but entails no difficulty and little expense.

In the meantime, especially in view of the fact that the market is restricted to a few buyers, there seems little purpose in advising the cultivation of this crop on estates.

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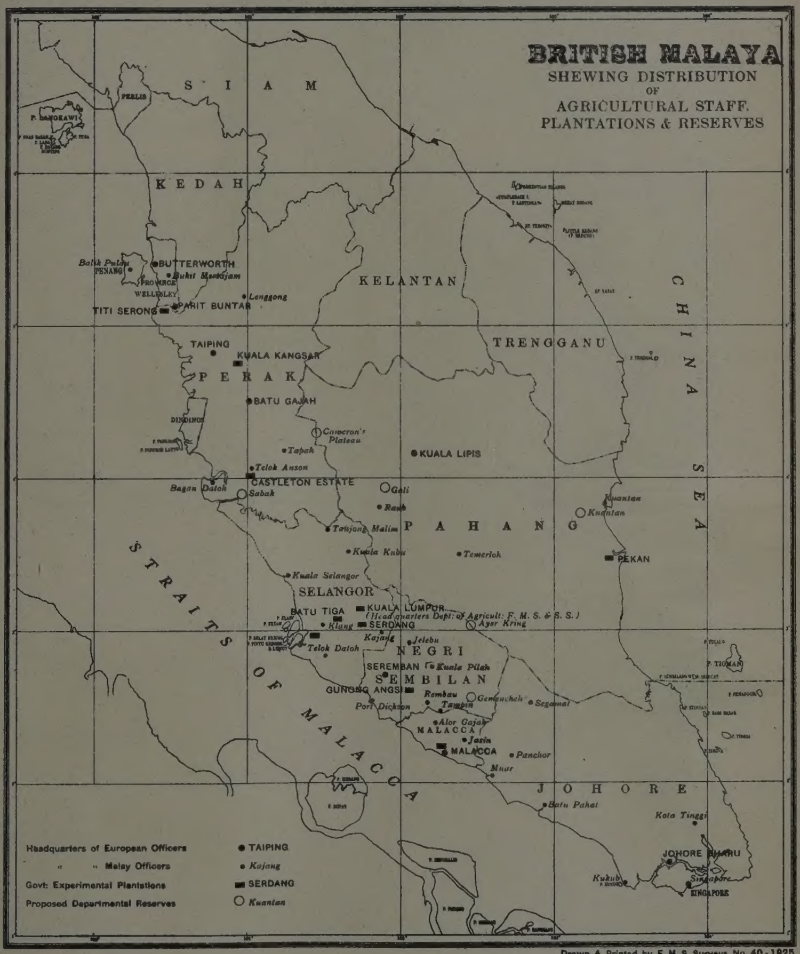

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